## **CLAIMS**

## What is claimed is:

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h	1	<b>-</b> 1.	A method for determining a logical path in a managed network between a source
	<b>1</b> <sub>2</sub>		device and a destination device at a data link layer, the method comprising the
	3		computer-implemented steps of:
	4		creating and storing a Connected Group Space representation of network devices
	5		based on a topology space representation of the network devices;
41-4	6		identifying an optimized path in the Connected Group Space representation;
	7		transforming the optimized path into the topology space representation; and
10	8		creating and storing the optimized path that was transformed into the topology space
mil Han Alawall Gus and Kal Ind	9		representation as the data link layer path.
101	1	2.	The method as recited in Claim 1, wherein the managed network is a managed IP
	2		network.
	1	3.	The method as recited in Claim 1, wherein the step of creating and storing a
	2		Connected Group Space representation further comprises the steps of:
	3		identifying a set of Connected Group nodes associated with the Connected Group
	4		Space representation;
	5		identifying Connected Group links that connect the Connected Group nodes; and
	6		creating and storing information that represents the Connected Group links.
	1	4.	The method as recited in Claim 1, wherein the step of creating and storing a
	2		Connected Group Space representation further comprises the steps of:

50325-088

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identifying a subnet associated with the source device and the destination device;

4		determining a set of network links that link one or more network devices in the
5		managed network; and
6		determining an assignment of ports of network devices.
1	5.	The method as recited in Claim 1, wherein the step of creating and storing a
2		Connected Group Space representation further comprises the steps of:
3		identifying all Virtual Local Area Networks (LANs) associated with a subnet
4		associated with the source device and the destination device; and
5		identifying all Emulated Local Area Networks (ELANs) associated with the subnet.
1	6.	The method as recited in Claim 1, wherein the step of creating and storing a
2		Connected Group Space representation further comprises the steps of:
3		creating one Connected Group node for any pairs of interfaces across a point-to-point
4		link in the topology space representation;
5		creating one Connected Group node for any interfaces of the managed network that
6		are directly connected by virtue of being on a same physical medium;
7		creating one Connected Group node for LAN Emulation interfaces on a same
8		Emulated Local Area Network (ELAN);
9		creating one Connected Group node for each internal interface of any network device
10		when the network device has an internal interface;
11		creating one Connected Group node for the source device;
12		creating one Connected Group node for the destination device; and
13		creating one Connected Group node for each user interface on any network device
14		when the network device has a user interface.

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1	7.	The method as recited in Claim 6, further comprising the step of determining
2		Connected Group links between Connected Group nodes in a subnet associated with
3		the source device and the destination device.
1	8.	The method as recited in Claim 7, further comprising the step of creating one
2		Connected Group link for each pair of interfaces within each network device, wherein
3		each interface is associated with the subnet of the source device and the destination
4		device and is in a forwarding state.
1	9.	The method as recited in Claim 8, further comprising the step of checking a spanning
2		tree status for each interface within each network device to determine whether the
3		interface is in the forwarding state.
1	10.	The method as recited in Claim 1, wherein the step of identifying an optimized path
2		in the Connected Group Space representation further comprises the step of finding a
3		shortest path between a Connected Group source node and a Connected Group
4		destination node.
1	11.	The method as recited in Claim 10, further comprising the step of using a Dijkstra
2		algorithm to find the shortest path between the Connected Group source node and the
3		Connected Group destination node.

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path into the topology space representation further comprises the steps of:

The method as recited in Claim 1, wherein the step of transforming the optimized

3		identifying an ordered set of Connected Group nodes associated with the optimized
4		path; and
5		identifying an ordered set of Connected Group links associated with the ordered set of
6		Connected Group nodes.
1	13.	The method as recited in Claim 12, further comprising the steps of:
2		identifying a pair of interfaces associated with each Connected Group link in the
3		ordered set of Connected Group nodes associated with the optimized path; and
4		generating an ordered set of topology space links from the pairs of interfaces
5		associated with Connected Group links.
1	14.	A computer-readable medium carrying one or more sequences of instructions for
2		determining a logical path in a managed network between a source device and a
3		destination device at a data link layer, wherein execution of the one or more
4		sequences of instructions by one or more processors causes the one or more
5		processors to perform the steps of:
6		creating and storing a Connected Group Space representation of network devices
7		based on a topology space representation of the network devices;
8		identifying an optimized path in the Connected Group Space representation;
9		transforming the optimized path into the topology space representation; and
10		creating and storing the optimized path that was transformed into the topology space
11		representation as the data link layer path.
1	15.	The computer-readable medium as recited in Claim 14, wherein the managed network
2		is a managed IP network

	1	16.	The computer-readable medium as recited in Claim 14, wherein the step of creating
	2		and storing a Connected Group Space representation further comprises the steps of:
	3		identifying a set of Connected Group nodes associated with the Connected Group
	4		Space representation;
	5		identifying Connected Group links that connect the Connected Group nodes; and
	6		creating and storing information that represents the Connected Group links.
	1	17.	The computer-readable medium as recited in Claim 14, wherein the step of creating
D M	2		and storing a Connected Group Space representation further comprises the steps of:
ŭ E	3		identifying a subnet associated with the source device and the destination device;
# 4	4		determining a set of network links that link one or more network devices in the
¥	5		managed network; and
- 4., 4 4., 4., 4., 4., 4., 4., 4., 4., 4	6		determining an assignment of ports of petwork devices.
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	1	18.	The computer-readable medium as recited in Claim 14, wherein the step of creating
1	2		and storing a Connected Group Space representation further comprises the steps of:
	3		identifying all Virtual Local Area Networks (VLANs) associated with a subnet
	4		associated with the source device and the destination device; and
	5		identifying all Emulated Local Area Networks (ELANs) associated with the subnet
	6		associated with the source device and the destination device.
	1	19.	The computer-readable medium as recited in Claim 14, wherein the step of creating
	2		and storing a Connected Group Space representation further comprises the steps of:
	3		creating one Connected Group node for any pairs of interfaces across a point-to-point
	4		link in the topology space representation;

50325-088

	5		creating one Connected Group node for any interfaces of the managed network that
	6		are directly connected by virtue of being on a same physical medium;
	7		creating one Connected Group node for LAN Emulation interfaces on a same
	8		Emulated Local Area Network (ELAN);
	9		creating one Connected Group node for each internal interface of any network device
	10		when the network device has an internal interface;
	11		creating one Connected Group node for the source device;
	12		creating one Connected Group node for the destination device; and
4	13		creating one Connected Group node for each user interface on any network device
# #### ####	14		when the network device has a user interface.
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m thru	1	20.	The computer-readable medium as recited in Claim 19, further comprising the step of
	2		determining Connected Group links between Connected Group nodes in a subnet
W. three that	3		associated with the source device and the destination device.
	1	21.	The computer-readable medium as recited in Claim 20, further comprising the step of
	2		creating one Connected Group link for each pair of interfaces within each network
	3		device, wherein each interface is associated with the subnet of the source device and
	4		the destination device, and is in a forwarding state.
	1	22.	The computer-readable medium as recited in Claim 21, further comprising the step of
	2		checking a spanning tree status for each interface within each network device to
	3		determine whether the interface is in the forwarding state.
	1	23.	The computer-readable medium as recited in Claim 14, wherein the step of
	2		identifying an optimized path in the Connected Group Space representation further

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3		comprises the step of finding a shortest path between a Connected Group source node
4		and a Connected Group destination node.
1	24.	The computer-readable medium as recited in Claim 23, further comprising the step of
2		using a Dijkstra algorithm to find the shortest path between the Connected Group
3		source node and the Connected Group destination node.
1	25.	The computer-readable medium as recited in Claim 14, wherein the step of
2		transforming the optimized path into the topology space representation further
3		comprises the steps of:
4		identifying an ordered set of Connected Group nodes associated with the optimized
5		path; and
6		identifying an ordered set of Connected Group links associated with the ordered set of
7		Connected Group nodes.
1	26.	The computer-readable medium as recited in Claim 25, further comprising the steps
2		of:
3		identifying a pair of interfaces associated with each Connected Group link in the
4		ordered set of Connected Group nodes associated with the optimized path; and
5		generating an ordered set of topology space links from the pairs of interfaces
6		associated with Connected Group links.
1	27.	A computer data signal embodied in a carrier wave, the computer data signal carrying
2		one or more sequences of instructions for determining a logical path in a managed
3		network between a source device and a destination device at a data link layer, wherein

50325-088

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execution of the one or more sequences of instructions by one or more processors
causes the one or more processors to perform the steps of:
creating and storing a Connected Group Space representation of network devices
based on a topology space representation of the network devices;
identifying an optimized path in the Connected Group Space representation;
transforming the optimized path into the topology space representation; and
creating and storing the optimized path that was transformed into the topology space
representation as the data link layer path.
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A computer apparatus comprising:
a processor; and
a memory coupled to the processor, the memory containing one or more sequences of

instructions for determining a logical path in a managed network between a source device and a destination device at a data link layer, wherein execution of the one or more sequences of instructions by the processor causes the processor to perform the steps of:

creating and storing a Connected Group Space representation of the network devices based on a topology space representation of the network devices;

identifying an optimized path in the Connected Group Space representation; transforming the optimized path into the topology space representation; and creating and storing the optimized path that was transformed into the topology space representation as the data link layer path.

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